[7590-01-P]

NUCLEAR REGULATORY COMMISSION

[Docket Nos. 50-369 and 50-370; NRC-2016-0128]

Duke Energy Carolinas, LLC and North Carolina Electric Membership Corporation

Acceptance Criteria for Emergency Core Cooling Systems

McGuire Nuclear Station, Units 1 and 2

Catawba Nuclear Station, Units 1 and 2

AGENCY: Nuclear Regulatory Commission.

ACTION: Exemption; issuance.

SUMMARY: The U.S. Nuclear Regulatory Commission (NRC) is issuing an exemption in response to a license amendment request and exemption request dated August 20, 2015, from Duke Energy Carolinas, LLC (Duke Energy or the licensee) from portions of the regulations to support the use of fuel that is clad in Optimized ZIRLO™.

ADDRESSES: Please refer to Docket ID **NRC-2016-0128** when contacting the NRC about the availability of information regarding this document. You may obtain publicly-available information related to this document using any of the following methods:

- **Federal Rulemaking Web Site:** Go to http://www.regulations.gov and search for Docket ID **NRC-2016-0128**. Address questions about NRC dockets to Carol Gallagher; telephone: 301-415-3463; e-mail: Carol.Gallagher@nrc.gov.

- **NRC's Agencywide Documents Access and Management System (ADAMS):**

You may obtain publicly-available documents online in the ADAMS Public Documents collection at http://www.nrc.gov/reading-rm/adams.html. To begin the search, select "ADAMS Public Documents" and then select "Begin Web-based ADAMS Search." For problems with ADAMS, please contact the NRC's Public Document Room (PDR) reference staff at 1-800-397-4209, 301-415-4737, or by e-mail to pdr.resource@nrc.gov. The ADAMS accession number for each document referenced (if it is available in ADAMS) is provided the first time that it is mentioned in this document.

- **NRC's PDR:** You may examine and purchase copies of public documents at the NRC's PDR, Room O1-F21, One White Flint North, 11555 Rockville Pike, Rockville, Maryland 20852.

FOR FURTHER INFORMATION CONTACT: G. Edward Miller, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, Washington DC 20555-0001; telephone: 301-415-2481, e-mail Ed.Miller@nrc.gov.

SUPPLEMENTARY INFORMATION:

I. Background

Duke Energy is the holder of Facility Operating License Nos. NPF-9, NPF-17, NPF-35, and NPF-52, which authorize operation of the McGuire Nuclear Station (MNS), Units 1 and 2, and Catawba Nuclear Station (CNS), Units 1 and 2. The licenses provide, among other things,

that each facility is subject to all rules, regulations, and orders of the NRC now or hereafter in effect.

The MNS and CNS units are pressurized-water reactor located in Mecklenburg County, North Carolina, and York County, South Carolina, respectively.

II. Request/Action

Pursuant to section 50.12 of title 10 of the *Code of Federal Regulations* (10 CFR), "Specific Exemptions," the licensee has, by letter dated August 20, 2015 (ADAMS Accession No. ML15295A016), requested an exemption from 10 CFR 50.46, "Acceptance criteria for emergency core cooling systems [ECCS] for light-water nuclear power reactors," and appendix K to 10 CFR part 50, "ECCS Evaluation Models" to allow the use of fuel rods clad with Optimized ZIRLO™. Section 50.46 requires that the calculated cooling performance following postulated loss-of-coolant accidents at reactors fueled with zircaloy or ZIRLO® cladding conforms to the criteria set forth in paragraph (b) of that section. In addition, appendix K to 10 CFR part 50, in part, requires that the Baker-Just equation be used to predict the rates of energy release, hydrogen concentration, and cladding oxidation from the metal/water reaction. The Baker-Just equation assumes the use of zircaloy or ZIRLO®, materials that have different chemical compositions from Optimized ZIRLO™. As written, these regulations presume only the use of zircaloy or ZIRLO® fuel rod cladding and do not contain provisions for use of fuel rods with other cladding materials. Therefore, an exemption from the requirements of 10 CFR 50.46 and part 50, appendix K, is needed to support the use of a different fuel rod cladding material. Accordingly, the licensee requested an exemption that would allow the use of Optimized ZIRLO™ fuel rod cladding at MNS and CNS.

III. Discussion

Pursuant to 10 CFR 50.12, the Commission may, upon application by any interested person or upon its own initiative, grant exemptions from the requirements of 10 CFR part 50, when the exemptions are authorized by law, will not present an undue risk to public health or safety, and are consistent with the common defense and security. However, § 50.12(a)(2) states that the Commission will not consider granting an exemption unless special circumstances are present as set forth in § 50.12(a)(2). Under 10 CFR 50.12(a)(2)(ii), special circumstances are present when application of the regulation in the particular circumstances would not serve, or is not necessary to achieve, the underlying purpose of the rule.

Special Circumstances

Special circumstances, in accordance with 10 CFR 50.12(a)(2)(ii), are present whenever application of the regulation in the particular circumstances is not necessary to achieve the underlying purpose of the rule. The underlying purpose of 10 CFR 50.46 and appendix K to 10 CFR part 50 is to establish acceptance criteria for ECCS performance to provide reassurance of safety in the event of a loss-of-coolant (LOCA) accident. Although the wording of the regulations in 10 CFR 50.46 and appendix K is not expressly applicable to Optimized ZIRLO™, the evaluations described in the following sections of this exemption show that the purpose of the regulations are met by this exemption in that, subject to certain conditions, the acceptance criteria are valid for Optimized ZIRLO™ fuel cladding material, Optimized ZIRLO™ would maintain better post-quench ductility, and the Baker-Just equation conservatively bounds LOCA scenario metal-water reaction rates and is applicable to Optimized ZIRLO™. Because the underlying purposes of 10 CFR 50.46 and appendix K can be achieved through the application of these requirements to the use of Optimized ZIRLO™ fuel rod cladding material,

the special circumstances required by 10 CFR 50.12(a)(2)(ii) for the granting of an exemption exist.

The Exemption is Authorized by Law

This exemption would allow the use of fuel rods clad with Optimized ZIRLO™ in future core reload applications for MNS and CNS. Section 50.12 allows the NRC to grant exemptions from the requirements of 10 CFR part 50 provided that the exemptions are authorized by law. The NRC staff determined that special circumstances exist to grant the proposed exemption and that granting the exemption would not result in a violation of the Atomic Energy Act of 1954, as amended. Therefore, the exemption is authorized by law.

No Undue Risk to Public Health and Safety

The provisions of 10 CFR 50.46 establish acceptance criteria for ECCS performance. Westinghouse topical reports WCAP-12610-P-A and CENPD-404-P-A, Addendum 1-A, "Optimized ZIRLO™," dated July 2006, contain the justification to use Optimized ZIRLO™ fuel rod cladding material in addition to Zircaloy-4 and ZIRLO®. The complete topical reports are not publicly available because they contain proprietary information, however, a redacted version and the NRC safety evaluation are available under ADAMS Accession No. ML062080569. The NRC staff found that the Westinghouse topical reports demonstrated the applicability of these ECCS acceptance criteria to Optimized ZIRLO™, subject to the compliance with the specific conditions of approval established therein. The NRC staff reviewed the August 20, 2015, application against these specific conditions and found that the licensee was in compliance with all of the applicable conditions. The NRC staff's review of these specific conditions for MNS and CNS can be found under ADAMS Accession No. ML16105A326.

Ring compression tests performed by Westinghouse on Optimized ZIRLO™ were reviewed and approved by the NRC staff in topical report WCAP-14342-A & CENPD-404-NP-A,

Addendum 1-A, and demonstrate an acceptable retention of post-quench ductility up to the 10 CFR 50.46 limits of 2,200 degrees Fahrenheit and 17 percent equivalent clad reacted. Furthermore, the NRC staff has concluded that oxidation measurements provided by Westinghouse illustrate that oxide thickness (and associated hydrogen pickup) for Optimized ZIRLO™ at any given burnup would be less than that for both zircaloy and ZIRLO™ (ADAMS Package Accession No. ML073130555). Hence, the NRC staff concludes that Optimized ZIRLO™ would be expected to maintain acceptable post-quench ductility.

The provisions of 10 CFR part 50, appendix K, paragraph I.A.5, "Metal-Water Reaction Rate," serve to ensure that cladding oxidation and hydrogen generation are limited appropriately during a loss-of-coolant accident (LOCA) and conservatively accounted for in the ECCS evaluation model. That regulation requires that the Baker-Just equation be used in the ECCS evaluation model to determine the rate of energy release, cladding oxidation, and hydrogen generation. Since the use of the Baker-Just equation presumes the use of zircaloy-clad fuel, strict application of the rule would not permit use of the equation for Optimized ZIRLO™ cladding for determining acceptable fuel performance. As concluded in the NRC staff safety evaluation for the associated topical report, Westinghouse demonstrated that the Baker-Just model is conservative in all post-LOCA scenarios with respect to the use of the Optimized ZIRLO™ as a fuel cladding material.

The NRC-approved topical reports have demonstrated that predicted chemical, thermal, and mechanical characteristics of the Optimized ZIRLO™ alloy cladding are bounded by those approved for ZIRLO® under anticipated operational occurrences and postulated accidents. Reload cores are required to be operated in accordance with the operating limits specified in the technical specifications and the core operating limits report.

Based on the above, no new accident precursors are created by using Optimized

ZIRLO™; thus, the probability of postulated accidents is not increased. Also, based on the above, the consequences of postulated accidents are not increased. Therefore, there is no undue risk to public health and safety due to using Optimized ZIRLO™.

Consistent with Common Defense and Security

The proposed exemption would allow the use of Optimized ZIRLO™ fuel rod cladding material at MNS and CNS. This change to the plant configuration is adequately controlled by TS requirements and is not related to security issues. Because the common defense and security is not impacted by this exemption, the exemption is consistent with the common defense and security.

Environmental Considerations

The NRC staff determined that the exemption discussed herein meets the eligibility criteria for the categorical exclusion set forth in 10 CFR 51.22(c)(9) because it is related to a requirement concerning the installation or use of a facility component located within the restricted area, as defined in 10 CFR part 20, and issuance of this exemption involves: (i) No significant hazards consideration, (ii) no significant change in the types or a significant increase in the amounts of any effluents that may be released offsite, and (iii) no significant increase in individual or cumulative occupational radiation exposure. Therefore, in accordance with 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the NRC's consideration of this exemption request. The basis for the NRC staff's determination is discussed as follows with an evaluation against each of the requirements in 10 CFR 51.22(c)(9)(i)-(iii).

Requirements in 10 CFR 51.22(c)(9)(i)

The NRC staff evaluated whether the exemption involves no significant hazards consideration using the standards described in 10 CFR 50.92(c), as presented below:

1. Does the proposed exemption involve a significant increase in the probability or consequences of an accident previously evaluated?

Response: No.

The proposed TS changes add flexibility in the selection of fuel rod cladding materials for use at CNS and MNS. The proposed change of adding a cladding material does not result in an increase to the probability or consequences of an accident previously evaluated. TS 4.2.1 addresses the fuel assembly design, and currently specifies that, "Each assembly shall consist of a matrix of either ZIRLO® or Zircaloy fuel rods . . ." The proposed change will add Optimized ZIRLO™ to the approved fuel rod cladding materials listed in this TS. In addition, a reference to the Westinghouse VANTAGE+ fuel assembly core reference report, WCAP-12610-P-A, and the topical report for Optimized ZIRLO™, WCAP-12610-P-A and CENPD-404-P-A, Addendum 1-A, will be included in the listing of approved methods used to determine the core operating limits for CNS and MNS given in TS 5.6.5.b. Westinghouse topical report WCAP-12610-P-A and CENPD-404-P-A, Addendum 1-A, Optimized ZIRLO™, provides the details and results of material testing of Optimized ZIRLO™ compared to standard ZIRLO®, as well as the material properties to be used in various models and methodologies when analyzing Optimized ZIRLO™. As the nuclear industry pursues longer operating cycles with increased fuel discharge burnup and fuel duty, the corrosion performance requirements for the nuclear fuel cladding become more demanding. Optimized ZIRLO™ was developed to meet these industry needs by providing a reduced corrosion rate while maintaining the composition and physical properties,

such as mechanical strength, similar to standard ZIRLO®. Fuel rod internal pressure has also become more limiting due to changes such as increased fuel duty and use of integral fuel burnable absorbers. Reducing the associated corrosion buildup by using Optimized ZIRLO™ in turn reduces temperature feedback effects, providing additional margin to the fuel rod internal pressure design criterion. Fuel with Optimized ZIRLO™ cladding will continue to satisfy the pertinent design basis operating limits, so cladding integrity is maintained. There are no changes that will adversely affect the ability of existing components and systems to mitigate the consequences of any accident. Therefore, addition of Optimized ZIRLO™ to the allowable cladding materials for CNS and MNS does not result in an increase in the probability or consequences of an accident previously evaluated.

The NRC has previously approved use of Optimized ZIRLO™ fuel cladding material in Westinghouse fueled reactors provided that licensees ensure compliance with the Conditions and Limitations set forth in the NRC Safety Evaluation for the topical report. Confirmation that these Conditions are satisfied is performed as part of the normal core reload process.

Therefore, the proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed exemption create the possibility of a new or different kind of accident from any accident previously evaluated?

Response: No.

The proposed TS changes add flexibility in the selection of fuel rod cladding materials for use at CNS and MNS. Optimized ZIRLO™ was developed to provide a reduced cladding corrosion rate while maintaining the benefits of mechanical strength and resistance to accelerated corrosion from potential abnormal chemistry conditions. The fuel rod design bases are established to satisfy the general and specific safety criteria addressed in the CNS and

MNS UFSAR [Updated Final Safety Analysis Report], Chapter 15 (Accident Analyses). The fuel rods are designed to prevent excessive fuel temperatures, excessive fuel rod internal gas pressures due to fission gas releases, and excessive cladding stresses and strains. Westinghouse topical report WCAP-12610-P-A and CENPD-404-P-A, Addendum 1-A, Optimized ZIRLO™, provides the details and results of material testing of Optimized ZIRLO™ compared to standard ZIRLO®, as well as the material properties to be used in various models and methodologies when analyzing Optimized ZIRLO™. The original fuel design basis requirements have been maintained. No new single failure mechanisms will be created, and there are no alterations to plant equipment or procedures that would introduce any new or unique operational modes or accident precursors. Therefore, addition of another approved cladding material of similar composition and properties as the current approved cladding materials to the CNS and MNS TS does not create the possibility of a new or different kind of accident or malfunction from those previously evaluated within the UFSAR.

3. Does the proposed exemption involve a significant reduction in a margin of safety?

Response: No.

The proposed change will not involve a significant reduction in the margin of safety because it has been demonstrated that the material properties of the Optimized ZIRLO™ are not significantly different from those of standard ZIRLO®. Optimized ZIRLO™ is expected to perform similarly to standard ZIRLO® for all normal operating and accident scenarios, including both loss of coolant accident (LOCA) and non-LOCA scenarios. For LOCA scenarios, where the slight difference in Optimized ZIRLO™ material properties relative to standard ZIRLO® could have some impact on the overall accident scenario, plant-specific LOCA analyses using Optimized ZIRLO™ properties demonstrates that the acceptance criteria of 10 CFR 50.46 has

been satisfied, therefore, the proposed change does not involve a significant reduction in a margin of safety.

Based on the above, the NRC staff concludes that the proposed exemption involves no significant hazards consideration. Accordingly, the requirements of 10 CFR 51.22(c)(9)(i) are met.

Requirements in 10 CFR 51.22(c)(9)(ii)

The proposed exemption would allow the use of Optimized ZIRLO™ fuel rod cladding material in the reactors. Optimized ZIRLO™ has essentially the same material properties and performance characteristics as the currently licensed ZIRLO® cladding. Thus, the use of Optimized ZIRLO™ fuel rod cladding material will not significantly change the types of effluents that may be released offsite, or significantly increase the amount of effluents that may be released offsite. Therefore, the requirements of 10 CFR 51.22(c)(9)(ii) are met.

Requirements in 10 CFR 51.22(c)(9)(iii)

The proposed exemption would allow the use of Optimized ZIRLO™ fuel rod cladding material in the reactors. Optimized ZIRLO™ has essentially the same material properties and performance characteristics as the currently licensed ZIRLO® cladding. Thus, the use of Optimized ZIRLO™ fuel rod cladding material will not significantly increase individual occupational radiation exposure, or significantly increase cumulative occupational radiation exposure. Therefore, the requirements of 10 CFR 51.22(c)(9)(iii) are met.

IV. Conclusions

Accordingly, the Commission has determined that pursuant to 10 CFR 50.12(a), the exemption is authorized by law, will not present an undue risk to the public health and safety, is consistent with the common defense and security, and that special circumstances are present to warrant issuance of the exemption. Therefore, the Commission hereby grants Duke Energy an exemption from the requirements of 10 CFR 50.46 and Appendix K, paragraph I.A.5 to 10 CFR part 50, to allow the application of these criteria to, and the use of, Optimized ZIRLO™ fuel rod cladding material at MNS and CNS.

This exemption is effective upon issuance.

Dated at Rockville, Maryland, this 21st day of June 2016.

For the Nuclear Regulatory Commission.

Anne T. Boland, Director,
Division of Operating Reactor Licensing,
Office of Nuclear Reactor Regulation.

[FR Doc. 2016-15548 Filed: 6/29/2016 8:45 am; Publication Date: 6/30/2016]